DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

3. Claims 20 and 22-28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Vollmar et al. (US 6,162,556) in view of Koga (US 6,033,634) and Deckman et al. (US 6,830,596).

Regarding claim 20, Vollmar discloses a method for converting CO from a feed (from the anode side of a fuel cell 4) and water into hydrogen (shift reaction, see abstract) wherein the feed (conduit 10) to the shift reactor (30) comprises anode off-gas (via conduit 10) from a fuel cell (4).

Vollmar teaches the use of a shift reactor on an anode off-gas stream and further discloses the use of a hydrogen separation apparatus (36) downstream of the shift reactor

to separate the hydrogen from the carbon dioxide, but does not explicitly disclose the structure of the shift reactor. In other words, Vollmar fails to teach:

converting CO on one side of a membrane in the presence of water to CO2 and H2O on said one side of said membrane, H2 passing through said membrane to the other side of said membrane and said hydrogen being combusted on said other side with oxygen fed to said other side.

Koga also discloses a shift reactor used for converting CO and H2O into hydrogen and CO2 (see abstract).

Koga teaches a membrane shift reactor which receives feed on one side of the membrane (in channel 8, see Fig. 1) and converts the CO in the feed in the presence of CO2 and H2O into H2 and CO2 (shift reaction, see abstract). Koga then teaches permeating the produced hydrogen through a membrane (12, 13, 14) and providing a stream of hydrogen (see Fig. 1). In other words, Koga teaches an integrated shift reactor and hydrogen separation method.

As such, it would have been obvious to one of ordinary skill in the art at the time of the invention to integrate the hydrogen separation step and the shift reaction step of Vollmar (as taught by Koga) in order to provide a more compact system (with the combination of two structures into one). Furthermore, the use of one piece of construction (as taught by Koga) instead of the multiple pieces of construction (as taught by Vollmer) would be merely a matter of obvious engineering choice and would have been obvious to one of ordinary skill in the art at the time of the invention (see MPEP 2144.04 (V)(B)).

Furthermore, Vollmar, as modified above by Koga, teaches a shift/membrane reactor which produces a stream of hydrogen gas which can be used for a plurality of purposes (see col. 6 lines 2-5 of Vollmar). However, Vollmar does not teach feeding oxygen to said other side of said membrane and combusting the hydrogen on the permeate side of the membrane.

Deckman also discloses a membrane reactor which comprises a shift catalyst and separates the hydrogen from the reaction effluent by allowing only the hydrogen to permeate through the membrane (see abstract).

Deckman teaches feeding oxygen to the other side/permeate side of the membrane (via conduit 8) and combusting the hydrogen on the permeate side of the membrane in order to produce a gas which can be used to power a turbine and generate electricity (see abstract).

As such, it would have been obvious to one of ordinary skill in the art at the time of the invention to add the oxygen introduction step and the hydrogen combustion process step of Deckman, to the process of Vollmar, in order to produce a gas which can be used to power a turbine and generate electricity.

Regarding claim 22, Vollmar further discloses that non-combusted oxygen (from source 12) is fed to a cathode (22) of a downstream fuel cell (4).

Regarding claim 23, Vollmar further discloses that said oxygen comprises is from air (col. 6 lines 58-65).

Regarding claim 24, Vollmar, as modified above, further discloses water is separated off from the off-gas originating from said one side of said membrane (water is separated in 34).

Regarding claim 25, Vollmar further discloses the heat from the off-gas from at least one of the sides of said membrane is recovered (via heat exchanger 32, for example, see Fig. 1).

Regarding claim 26, Vollmar, as modified by Deckman above, further discloses an oxygen-containing gas (for combustion of the hydrogen, as mentioned above) is introduced on said other side of the membrane under elevated pressure (effluent is fed to a turbine, indicating that the feed to the turbine is at a substantially elevated pressure).

Regarding claims 27 and 28, Vollmar does not disclose gas containing water originating from the other side of said membrane is fed to a further step for converting CO on one side of a further membrane in the presence of water to give CO2 and H20 on the one side of said further membrane, H2 passing through said further membrane to the other side of said further membrane. However, such a modification is nothing more than a duplication of the membrane disclosed by modified Vollmar and discussed above. Providing a duplicate membrane would amount to a mere duplication of parts and process steps. It has been held that mere duplication of parts has no patentable significance unless a new and unexpected result is produced. *In re Harza*, 274 F.2d 669, 124 USPQ 378 (CCPA 1960).

4. Claims 21 and 39 are rejected under 35 U.S.C. 103(a) as being unpatentable over Vollmar et al. (US 6,162,556) in view of Koga (US 6,033,634) and Deckman et al. (US 6,830,596) as applied to claim 20 above and further in view of Iio et al. (US 2002/0068204).

Regarding claims 21 and 39, Vollmar teaches a cathode off-gas which comprises air (col. 7 lines 35-43) but fails to teach that the oxygen used to combust the hydrogen comes from the cathode off-gas.

Iio also discloses a process in which the anode-off gas from a fuel cell is combusted to generate heat (see abstract).

Iio teaches combusting the hydrogen-containing anode off-gas with oxygen from the cathode off-gas as a means to supply oxygen to the combustion reaction (see paragraph 24).

As such, it would have been obvious to one of ordinary skill in the art at the time of the invention to combust the hydrogen of modified Vollmar, with the cathode exhaust gas (which comprises air), as taught by Iio as a preferable means to provide oxygen to the hydrogen combustion reaction.

Response to Arguments

5. Applicant's arguments filed 9/18/09 have been fully considered but they are not persuasive.

On page 9, Applicant argues that Deckman is not combinable with Vollmar because Deckman teaches a reforming reaction along with a CO shift reaction, and therefore, does not teach "converting CO from a feed" on the one side of the membrane. The examiner respectfully

disagrees with this argument. As disclosed in the rejection above, the limitation "CO from a feed" is met by the Vollmar reference which teaches sending anode off gas (containing CO) to a shift reactor. As best understood, Applicant is arguing modifications to the Vollmar reference that were not made by the examiner. Deckman was merely used to indicate a usage of permeated hydrogen through a membrane (regardless of where that hydrogen came from) that comprises combustion in order to power a turbine or generate electricity. In other words, Vollmar was not modified with the reforming catalyst and shift catalyst of Deckman, but rather the permeate hydrogen being used to generate electricity.

The previous objection to the IDS for missing foreign references is withdrawn in light of the PTO's receipt of copies of said foreign references. The references have now been considered.

Conclusion

6. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event,

however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to MATTHEW J. MERKLING whose telephone number is (571)272-9813. The examiner can normally be reached on M-F 8:30-4:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Alexa Neckel can be reached on (571) 272-1446. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/M. J. M./
Examiner, Art Unit 1795

/Alexa D. Neckel/
Supervisory Patent Examiner, Art Unit 1795